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The Effects of Information Technology on Intra-Human Communication in the Workplace

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ABSTRACT

The aim of this report is to summarise key aspects of human interaction that may be affected by the introduction of the Battlefield Command Support System (BCSS) to the Australian Army. Specific areas of analysis include the social nature of knowledge, implicit communication processes, and team processes. There is also discussion of common misperceptions regarding the promise of computers, and successful and unsuccessful methods of introducing new technology in relation to human interaction. It is concluded that successful design and integration of BCSS requires a deep understanding of the implicit aspects of human behaviour, and the contribution of the social fabric. A series of suggestions on how this could be achieved is provided.

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Executive Summary

The Australian Army is currently introducing information technology (IT) systems into tactical Command and Control (C2) operations. This has involved the insertion of the Battlefield Command Support System (BCSS) across levels and within both combat and support organisations. Human user requirements that should be considered in the design and integration of BCSS range from the shape and colour of icons on the interface, to the way humans interact in the workplace. Over recent years, greater attention has been paid to human-computer interface requirements. In contrast to this, there has been negligible attention paid to the possible effect of IT systems on human interaction. This report attempts to address this by summarising the following key aspects of human interaction that may be affected by IT:

1. The social nature of knowledge
2. Implicit communication processes
3. Team processes

To further understand the social requirements of IT management, there is also discussion of common misperceptions regarding the promise of computers, and successful and unsuccessful methods of introducing new technology in relation to human interaction.

In summary, successful IT design and integration is seen as requiring a deep understanding of the implicit aspects of human behaviour, and the contribution of the social fabric. In terms of a system such as BCSS, then, it is vital that we recognise the importance of socially held knowledge. Specific recommendations regarding the design and integration of BCSS include the following:

1. The communication method must allow high media richness when tacit knowledge is involved;
2. Planning activities should support the use of implicit communication;
3. The use of directive control (mission command) should be supported;
4. Realistic expectations need to be set as to the actual capability of the system;
5. An appropriate level of technical support needs to be provided, no matter what the cost;
6. Users must be allowed to adopt the system for everyday tasks before they are expected to undergo process change;
7. Computer literacy must not become a pre-requisite for command;
8. BCSS usability needs to be evaluated in terms of isolated users; and
9. Research is required into changes that BCSS may have on the division of labour.

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Contents

1. Introduction

The Australian Army is currently introducing information technology (IT) systems into tactical Command and Control (C2) operations. This has involved the insertion of the Battlefield Command Support System (BCSS) across levels and within both combat and support organisations. The BCSS is a computer-based IT system intended to provide command support functions to Army tactical Commanders and their command teams. It encompasses automated systems and processes, decision support tools, information integration and display, as well as communication systems. For example, the radio network is now supplemented by an electronic text messaging system. There is also the potential for information from remote unmanned sensors to be collected and analysed using software, and then displayed on the human-computer interface for interpretation.

The promise of introducing this type of IT into the military can be found in the US Army doctrine. The US Army Field manual 71-3 argues that these systems provide a common shared situation awareness that enables commanders and staff to make more informed decisions faster (Gregory & Kelly, 1998). The usefulness of computers to organise information, to analyse trends and to process vast amounts of data cannot be denied. However, the change to a new work system does have the potential to disrupt an already efficient performance. According to the US Army field manual 71-3 (cited by Gregory & Kelly, 1998), the success of IT integration depends on the management of numerous elements, including computer processing, advanced software, displays, sensor, communications and position/navigation components. Notably, the manual does not refer to one of the most important components of the process – the human user.

Human user requirements that should be considered in the design and integration of IT systems range from the shape and colour of icons on the interface, to the way humans interact in the workplace. Over recent years, greater attention has been paid to human-computer interface requirements. In contrast to this, there has been negligible attention paid to the possible effect of IT systems on human interaction. Undoubtedly, attention given to the information and the technology is critical if there is going to be a successful system. However, attempts to design systems from only this perspective call to mind the work of the Greek mythological bandit Procrustes. He stretched travellers who were too short and cut off the legs of those who were too long until they fitted his bed. The stretching and cutting done to meet the requirements of IT distorts much that is critically human (Brown & Duguid, 2000). Moreover, emerging evidence suggests that the development of a comprehensive theory of IT requires that attention be given to social relationships as well as to the technologies used to preserve and transmit information (Couch, 1996). This report will attempt to address this by summarising the following key aspects of human interaction that may be affected by IT:

1. The social nature of knowledge
2. Implicit communication processes
3. Team processes

In order to further understand the social requirements of IT management, there will also be discussion of common misperceptions regarding the promise of computers. As will be discussed, unrealistic expectations can hamper attempts to introduce IT. Finally, there will be a brief examination of some successful and unsuccessful methods of introducing new technology in relation to human interaction.

2. The Social Nature of Knowledge

Living in the so-called information age occasionally feels like being driven by someone with tunnel vision. Some of the drivers appear to assume that if we focus enough on information, we will get where we need to go. However, the myth of information is overpowering richer explanations of social knowledge. Moreover, the information focus has a tendency to treat people as more or less interchangeable consumers and processors of information, rather than bearers of knowledge. Attending to knowledge returns attention to people, what they know, how they come to know it, why they need it, and how they differ. This section will examine some of the evidence for the existence and importance of socially held knowledge

2.1 Tacit versus Explicit Knowledge

Individuals do not operate organisations. Instead, organisations are social entities, with socially held or shared knowledge. The type of knowledge includes expertise on product development, best practices (Trussler, 1998), process improvement discoveries (Scheraga, 1998), knowledge about customers' needs (Hiebeler, 1996), and customers' habits and attitudes (Krogh, 1998). The types of shared knowledge can be classified according to the tacit-explicit dimension (Brown & Duguid, 1991; Nonaka & Takeuchi, 1995).

Polanyi (1966) was the first to distinguish between tacit and explicit dimensions of knowledge. The explicit dimension is like the strategy book. However, it is relatively useless without the tacit dimension, which allows people to know when to apply the explicit part. Explicit knowledge is considered to be objective and can be expressed unambiguously in words, numbers and specifications. Hence, it can be transferred via formal and systematic methods in the form of official statements, rules and procedures (Nonaka & Takeuchi, 1995; Polanyi, 1966). Explicit knowledge in the military is usually recorded as doctrine. On the other hand, tacit knowledge is subjective, situational and intimately tied to the knower's experience (Kidd, 1998). Tacit military knowledge is often found within the so-called intuitive process of planning and decision-making. It cannot be formalised, documented or easily communicated to others. Insights, intuition, beliefs, personal skills and craft, and using rule-of-thumb to solve a complex problem are examples of tacit knowledge.

Knowledge is harder to detach than information. People treat information as a self-contained substance. It is something that people pick up, possess, pass around, put in a

database, lose, find, write down, accumulate, count, compare and so forth. Knowledge, by contrast, does not take as kindly to ideas of shipping, receiving and quantification. It is hard to pick up and transfer. Knowledge is also something we digest rather than hold. It entails the knower's understanding and some degree of commitment.

2.2 Storytelling and Tacit Knowledge

Tacit knowledge is often generated using storytelling. Narration is a key aspect of this type of social exchange. Constant storytelling – about problems and solutions, about disasters and triumphs – over lunch and coffee, serves a number of overlapping purposes. People tell stories about unsolved problems in an attempt to generate a coherent account of what the problem is and how to solve it. War stories told in the Mess or during "mornos" allow military personnel to share their expertise and insight from operational experiences. They can do this collectively as they draw on the wisdom and experience of the group.

Stories are a good way of presenting things sequentially (this happened, then that) and causally (this happened because of that). This means that they are a powerful means to understand what happened. In addition, the value of stories lies not just in their telling but also in their re-telling. Stories pass on to newcomers what old-timers already know. Stories are thus central to learning and education, and they allow personnel to learn from one another. Stories also allow a shared interpretation. In storytelling, teams develop a common framework that allows them to interpret incoming information in a common light. This suggests, then, that severing the ties that bind people together in work may be as damaging as binding them together more tightly, as it would remove a rich source of insight generation.

2.3 Severing Social Ties

Another problem that can emerge if social ties are severed relates to the constant upgrading that occurs during an evolutionary IT design. If there are not enough technicians to manage transformations to the new version, or easily accessible peers to share the burden of using a difficult system, the weight of continuous product innovation can be unsupportable. Brown and Duguid (2000) cite a case where an apparently intelligent and hardworking woman was having extreme difficulties with a new IT system. By chance, her desk was moved from an isolated spot into the centre of a group of offices. She benefited immediately from the incidental learning. She saw that the "stable" machines crashed for everyone, and that when people had trouble, they would look around for someone to help them.

The critical point in this example is that no one person knew how to handle the machine. However, spread around the office was enough collective knowledge to keep them up and running. The office social system plays a major part in keeping tools (and people) up and running. The "geek" who understands the network, the secretary who knows the secrets of Word, the one colleague proficient with databases, the other who has learned Java in her spare time, and the one who knows how to nurse the server, all contribute. It would

not be far-fetched to suggest a similar level of collective knowledge would be found in a military HQ. The facts of the office life often reveal a combination of technological frailty and social resourcefulness. If a BCSS user does not have access to this social resourcefulness, there is a strong likelihood that they will have some difficulty dealing with constant upgrades. As will be discussed in Section 6.2.2, it is important that the BCSS learning environment includes in-Barracks use. This will allow users to make use of social networks without the added time pressure involved in achieving operational requirements in the field.

2.4 Tacit Knowledge in a Distributed Workgroup

Brown and Duguid (2000) provide an example of the necessity of tacit knowledge in a distributed workgroup of technicians who "survived" via daily social exchange. The technicians' workday began at 9 am, but the informal day was actually starting at breakfast. From a conventional perspective, their job appeared to be highly individual. There was a team that covered the same geographical area, individual representatives were responsible for specific accounts, and there were specialists whom a representative could call on if he or she got into difficulties. Routine work was carried out alone at the customers' site. However, the representatives were remarkably social, getting together on their own time for breakfast, lunch, coffee, or at the end of the day. This sociability was not simply a retreat from the loneliness of an isolating job. At these meeting, while eating, playing cribbage, and engaging in what might seem like idle gossip, the representatives talked work, and talked it continuously. They posed questions, raised problems, offered solutions, constructed answers, and discussed changes in their work, the machines or customer relations. In this way, both directly and indirectly, they kept one another up to date with what they knew, what they learned, and what they did. This is somewhat analogous to conversations held by military personnel during "mornos", and other social encounters.

The constant exchanges the representatives engaged in are also similar to the useful background updating that goes on constantly in a military HQ, where people simply become aware of what others are up to because it is evident. There too, this sort of chat usually passes unnoticed (unless someone were to object to it as time wasting, or an IT system were to create a text only communication environment). However, while only a fraction may involve directly informing others about explicit business or tactical matters, this talk is valuable for updating tacit knowledge. Chat continuously but almost imperceptibly adjusts a group's collective knowledge and individual members awareness of each other. The informal and extracurricular group helped each member to reach beyond the limits of an individual's knowledge and of the process documentation.

Socially held knowledge also ensures smooth transitions where one member leaves the workplace or when several members of a military HQ depart for new postings. Social relationships are relatively constant and they provide a degree of transituational consistency to human action. They are used by people to structure actions with, and with respect to, one another (Couch, 1996).

2.5 Implications of Social Knowledge for Communication Media

Most communication, both that which employs a technology and that which does not, is conceptualised by social relationships (Couch, 1996). It is clear that tacit knowledge sharing requires organisation members to engage in social interaction with each other (Nonaka and Takeuchi, 1995; Davenport & Prusak, 1998). The media through which knowledge sharing takes place are the various communication channels available in the organisations (Daft, Bettenhausen, & Tyler, 1993; Krone, Jablin, & Putnam, 1987). Hence, knowledge sharing has to be compatible with the media richness of the channel. For example, knowledge such as belief and insight (which are more tacit in nature) can be shared more easily through a communication channel with high media richness (such as face-to-face conversation) than through that with low media richness (such as a text-only document) (Madhavan & Grover, 1998). Conversely, the sharing of explicit knowledge tends to involve the use of document-based channels (Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998; Morten, Nohria, & Tierney, 1999).

In a military environment, this would equate to the premise of general administrative management remaining the province of the text-based communication. In contrast to this, the tacit characteristics of planning and command require high media richness. At the very least, they should be voice-based. Attempting to incorporate these areas into a text-based system runs the risk of losing a rich source of knowledge. Ideally, the, planning and command will remain face-to-face, even if this requires the additional technology of video conferencing facilities[1].

3. Implicit Communication

A consequence of the generation of tacit knowledge is that it allows the use of implicit communication. Implicit communication allows us to take communicative shortcuts when collecting, interpreting and analysing information, when seeking consensus, or during decision-making. It is particularly valuable during military operations that are time-pressured. This section summarises some forms of implicit communication that are used in the workplace that need to be considered during the design and integration of IT systems.

3.1 Understanding the Unspoken

When we think of the way we interact, talk may deliver information – something that can be recorded, transcribed, digitised, and shipped in packets. However, as you talk, listeners set what you say in a much larger context. Your appearance, your age, your accent, your background, and the setting all contribute to what they understand. In a military

[1] Critics may say that an insistence on face-to-face communication is "old-fashioned". However, if we are to enhance C2, we must recognize how humans optimally perform, and then provide the technology to support that performance.

environment, this type of information can provide a great deal of information about the intent (eg. urgency).

We are all remarkably good at picking up clues and cues that underwrite what a speaker says. People go beyond information to triangulate reliability, meaning that con artists and actors have to work for a living. We look for other ways to gauge trustworthiness, including informal methods such as dress, tone, and expression. Cutting off such resources can make a significant difference to perceptions. For example, after the historic Nixon-Kennedy debate in 1960, the majority who listened to the radio judged Nixon the winner, while those who watched the television coverage judged Kennedy the winner. The visual cue provided information on the speakers' level of ease (Brown & Duguid, 2000). In the tight restrictions of the information channel, without the corroboration that broader context offers (or refuses) the powerful detective skills that everyone relies on have little room to work. This suggests that if a military plan or command statement is exclusively the province of the text-based media channel, it will likely lead to an erosion of intent reliability.

3.2 Collective Communication

In terms of the implicit, it is also useful to consider the way people negotiate with one another in the flow of collective communication. Conversations demand individual and collective decisions over who will speak, when, and for how long. In informal conversation, the negotiations involved in such turn taking, though rapid and efficient, are all but invisible. To claim a turn, people will merely shift their gaze, subtly alter their body position, or wait for a break to interject. Others will turn from or toward them, inviting them in or leaving them out. Speakers will hand off the conversation with a look, rising intonation, or a direct question to another person. Or they may attempt to keep hands on by avoiding eye contact, speaking rapidly, rejecting counteroffers, or pausing only at words like *and* or *so*.

There are also completely speechless negotiation practices. The way people on a crowded street negotiate a passage, pulling to one side and another, standing back, hurrying forward, dropping into single file, the falling back to two abreast and so forth. All of this is done with rarely a word among people who have never seen each other before and will never see each other again. Such negotiation does not rely on simple rules like "keep left" or "keep right". Rather it is a dynamic process. It is only too noticeable when it fails, when, for example, both pull in the same direction, stepping toward the street, then toward the wall, then back again, each time finding the same person in the way.

In conversation, such impasses bear a resemblance to a committee, where implicit communication rarely works. Then, participants have to invoke formal rules: the right to speak, the right to resist interruption, the order of speakers, the topics permitted, the length of time permitted, the length of time allotted, points of order, and so forth. This sort of explicit, rule-governed negotiation is clumsy, but necessary when the social fabric will not bear implicit negotiation. This is the type of thing IT developers often have in

mind when they think of communication negotiation, but it is only a small portion of what human negotiation involves.

This also relates to the planning process. When a group of military experts conduct a planning session, there is a vast pool of implicit understanding. The speechless negotiation and unspoken communication rules allow the communicative shortcuts that are so necessary for interpreting and analysing information, lateral thought, and creative solutions. Formalising this via an IT conduit risks turning military planning into a committee meeting!

3.3 Rules, Goals and Sympathetic Disobedience

To understand human negotiation requires understanding humans as more than simple goal pursuing agents. For humans, rules and goals bear a complicated relationship to the social fabric. Both may shift dramatically in practice depending on the social conditions that prevail. Goal shifting regularly occurs, and is highly evident when people negotiate directly with one another. In interpersonal negotiation, people change their immediate goal for the sake of the higher goal of preserving the social conditions that make negotiation possible. For example, people will back off demands, even if they are in the right, because asserting rights may damage the social fabric.

People also abandon rules. Authorities, for example, turn a blind eye if they sense that enforcing the law could be more damaging. In such situations, people implicitly invoke the axiom that if following the rules causes damage, then abandon the rules. Such an approach is critical in the military as it allows personnel the local autonomy to deal with the unexpected when time-pressures are involved. IT favours the direct and explicit side of human negotiation. It is blind to the complex social trade-offs between goals, rules, and the social fabric. It is no surprise that it is capable of tearing holes in the social fabric. Clearly, then, if a tool such as BCSS attempts to enforce such a rule-bound system on the complex practice of C2, it will create difficulties.

If humans are not strict in following rules, they are far worse at laying them out. Human delegation relies as much on sympathetic disobedience when circumstances change as it does on strict obedience. Strict obedience leads to disaster. Giving orders that have to take account of all possibilities is impossible in all but the simplest tasks. Consequently, rules, contracts, delegation, and the like rely on unspecifiable discretion and judgement on the part of the person following those orders. The military's use of *mission command* (otherwise known as directive or decentralised control), where the achievement of intent is not specified by a series of explicit rules, is consistent with this optimal pattern of human behaviour. When using mission command, the actors within the field have the authorisation to make any decisions that they deem necessary, as long as they are consistent with the overall commander's intent. This approach is used when there is a large volume of information or the problem is too complex for a single actor to adequately manage (Artman, 1998). It is critical, then, that the integration of the potentially rule-

bound BCSS does not remove the local autonomy of personnel to act with sympathetic disobedience when dealing with unexpected, time-pressured events.

4. Formal Teams and IT Integration

The above sections have focussed on the informal social groupings that exist in the workplace. A second form of human interaction in the workplace involves the formal team. While many of the above characteristics apply to formal teams, there are several other factors that need to be considered in relation to the design and integration of IT.

4.1 Teamwork and Shared Mental Models

Salas, Dickinson, Converse, and Tannenbaum (1992) define a team as:

> A distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited lifespan of membership. (p.4)[2].

This definition suggests that the development of a shared mental model (SMM) that allows the use of implicit communication and coordination is particularly important in achieving team goals. Pascual (1999) argues that mental models are cognitive mechanisms that give structure to information based on previous experiences and knowledge. The term 'shared' refers to the fact that team members hold the same information regarding certain scenarios, interactions or communication patterns. As a result of their pre-existing knowledge of teammate's expertise, task orientation and organisational knowledge, teams that possess similar SMMs or team knowledge are thought to have less need to communicate (Cannon-Bowers, & Salas, 1997; Cooke, Salas, Cannon-Bowers, & Stout, 2000).

Consistent with the SMM research, Mathieu, Goodwin, Heffner, Salas, and Cannon-Bowers (2000) found that team knowledge convergence (regarding the knowledge, skills, attitude and expertise of their team mates) was significantly related to team performance. This finding implies that knowledge of other team member's knowledge can be used as an effective predictor of performance outcomes (Cook, Elder, & Pascual 1999; Entin & Serfaty, 1999). Teams who have accurate and shared knowledge of what each team member knows are better able to predict their performance and can therefore adapt and coordinate their task approach to maximise efficiency (Cannon-Bowers & Salas, 1998; Cannon-Bowers, Salas, & Converse, 1993; Mathieu et al, 2000). It has also been suggested that elite/expert teams display more implicit communication and coordination, particularly in

[2] This definition has been widely used in teamwork research since its development in 1992.

high workload situations (Cannon-Bowers et al., 1993; Cooke et al., 2000; Entin & Serfaty, 1999; Serfaty & Entin, 1998; Stout, Salas, & Fowlkes, 1997). For example, Entin and Serfaty (1999) found that teams that adopted communication and coordination strategies that reduced the effort involved in meeting certain task demands, maintained their performance output even in high workload situations.

4.2 The Distributed Team Dilemma

A possible ramification of the introduction of a command support system to a military environment is that it may remove or reduce the ability of a team to operate in this implicit fashion. Many of the IT difficulties reflect a misunderstanding of teamwork, which is too easily painted as information handling. This has led to the belief that many workers and managers can work at home or that military teams can be distributed across time and/or space. The idea of team members and/or managers working remotely with information inevitably ignores the much more difficult, intangible, but inevitable face-to-face side of things – the interaction with people and knowledge, and not information, and the importance of the planning processes in generating the shared mental model.

In addition, in attempting to replace outmoded ways of doing things, new technologies also displace work tasks that were once successfully shared across a team. Desktop publishing, for example, tries to put in a box, all the tools that previously were distributed among a publishing team (i.e. authors, editors, copy editors, proofreaders, designers, typesetters and printers). Each team member had their own embodied, inarticulate skill and judgement built out of experience (Hammer & Champey, 1993).

In the transition to home offices and distributed teamwork, these burdens pass from the social system, where tasks and are shared, and understanding is implicit, onto the lap of individuals. Ironically, the desire to show that with a computer one person can be isolated, and can do everything may not look forward, but back to the stage in social evolution before anyone noticed the advantages of the division of labour. It is important then for research into the changes that BCSS may have on the division of labour; specifically, the implications for the loss of narrow, but highly specialised skill sets in favour of broader, more generalist capabilities. It may be the case that there are areas of military performance where generalists are appropriate. For example, when it is only possible to send a small number of people into an environment that requires adaptability and flexibility, generalists are possibly more effective. Other situations, however, will likely benefit from highly specialised personnel.

5. Mythological Perceptions of IT

An often overlooked influence on the success of IT integration relates to current perceptions of the promise of IT. The instability that rapidly changing technology brings

often lies less in the technology itself than in enthusiastic expectations that everything being "just a click away" or "at your fingertips" will make life easy. Battered by such hype, it is easy to believe that everyone except you knows how to use this stuff without a problem. This may reduce the likelihood that a struggling user will request assistance. It may also have the effect of allowing system designers and/or managers to blame the user for the problems they are having. Recent interviews with personnel from 1 and 3 Bde suggest that while users appear to be relatively positive about BCSS, the expectations of what the system is able to do may be disproportionately high[3]. This section, then, will summarise just a few examples that highlight the false mythological status given to IT.

5.1 The Internet as a Resource?

The Internet is championed as a major information resource, yet a little time in the nether regions of the web can end up as a quest search through an unstoppable flood of meaningless information. To explore the strengths of the Internet, it is important to recognise its limitations. Brown and Duguid (2000) sent Sherlock out on a task to look for others of its own kind (a knobot) – a simple task, one would think. Using about 6 major search engines, Sherlock returned 51 hits. Analysis showed that:

- 7 were repeats
- 3 were mirror sites
- 11 pointed to a document that did not exist
- 4 pointed to a document with a dead link
- 2 did not contain the word *knobot*
- 16 led to a single document where the word was used in passing
- 4 led to glossaries that defined the word so people could read documents containing the word
- 4 led to 2 documents at Stanford uni that outlined how knobots could make the web more usable

While this may seem somewhat extreme, most regular users of the Internet would be empathetic with the above example. However, if the myth of the IT revolution persists, users feel inadequate, which then reduces the likelihood of future IT acceptance. Moreover, they may persist in trying to use the inadequate IT, wasting costly time. In a military environment, if this type of futile persistence occurs during an operation, the cost can be particularly high.

5.2 Computer Literacy

The concept of computer literacy assumes that in order to use computers, people need some fundamental training. We tend to see this as "fair enough". It could be argued though, that computer literacy is an unreasonable demand. While it makes the software

[3] These interviews are currently being written up as a client report by Chapman, T., Mills, V. & Temby, P. and are available on request.

development process easier, it hampers the growth of society. Users should not have to master computers to be able to perform rudimentary tasks (eg. to use a VCR or microwave). Nor should users who are trained in a domain have to learn to use a computer to be able to perform their job. For example, a qualified accountant should not have to be computer literate to be able to run an accounting practice. Likewise, an experienced military commander should not need computer savvy to be able to lead an operation. However, this is the expectation that has developed. It is also important to note that we are currently in an era where the more experienced Commanders tend also to be of the generation that are not overly familiar with computers. If lack of computer literacy excludes their tacit knowledge, it will be an irretrievable loss.

5.3 IT and the Decreased Sharing of Power

It has long been assumed that IT will lead to flatter organisational structures and the sharing of power. However, Zuboff (1988) and Lohr (1996) note that the paradise of shared knowledge and a more egalitarian working environment is just not happening. If power is not shared, it is because management does not want to share authority and power. This is a problem of culture, not technology. This also shows that technology solutions that ignore cultural rituals are almost certainly doomed to fail. Moreover, IT has the potential to further disempower lower levels. Fidler (1997) notes that U.S. navy commanders understood the potential of IT to disempower them when they resisted the introduction of Marconi's ship to shore radio. They realised that once orders could be sent to them on-board, they would lose their independence of action.

Fukuama and Shulsky (1997) conducted a RAND study into the relationship between disintermediation (removing the middleman), flat organisations, and centralisation on behalf of the Army. They began by studying the private sector. Here they give little hope for any direct link between IT and flatter organisations. Indeed, they believe that the conventional argument that IT will lead to flatter organisations is an infocentric one that focuses on a single, if very important, function of middle management: the aggregation, filtering, and transmission of information. It is of course precisely with respect to this function that advances in IT suggest that flattening is desirable, since IT facilitates the automation of much of this work. On the other hand, middle management serves other functions as well. If the role of managers is primarily information processing, then information-processing equipment might replace them, and organisations will be flatter. If, on the other hand, there is more to management than information processing, then linear predictions about disintermediation within firms are too simple.

5.4 Economic and Social Disruptions

Rather than resulting in an economic boom, the introduction of computers has caused widespread economic disruption, limiting growth in productivity. In fact, there has tended to be a slump in productivity whenever industry undergoes major retooling (David, 1990). Attelwell (1994) notes that information overhead, far from being curtailed by the introduction of office automation and subsequent information technologies, has increased

steadily across a broad range of industries. When there is a major change, there follows a long period in which it is also both too expensive and too frail for widespread social adoption. Gradually it becomes more robust, cheaper and more useful. It is taking time for society to transform from the Fordist regime of mass production to the new regime of digital tools and demassification.

It is also important to note that social, political and economic systems change incrementally, but technology can change exponentially (Downes & Mui, 1998). To accuse society of lagging, however, lets technology off the hook too easily. It implies in the end, that you can tear down walls, issue laptops, and cell phones, or send people home with industrial strength technology and then blame them if they do not adjust. It could be argued that technology design has not taken adequate account of work and its demands but instead has aimed at an idealised image of individuals and information.

5.5 The Futz Factor

Most businesses well endowed with IT lose about $5000 per year per workstation as a result of the need for "futzing". The futz factor refers to the time users spend in a befuddled state while clearing up unexplained happenings and overcoming the confusion and panic when computers produce enigmatic messages that stop work (Strassman, 1997). Home office workers and distributed team members lack the peer support, so the amount of time spent futzing increases substantially.

Notably, the futz factor is often hidden from those at the top. For example, at Xerox the most common encounters between senior management and copiers is when new machines are presented for their inspection. Inevitably in such encounters, people whose jobs relied on it going well surrounded the managers. Consequently, as managers experimented, the correct finger was edged toward the correct button at the correct time in a thousand barely perceptible ways. What everyone took to be a successful encounter between an individual, instructions, and the copier, was actually an encounter made successful by an informal and almost invisible social network working hard to prevent the embarrassment of failure to all (Brown & Duguid, 2000).

A point to consider is that BCSS user workshops tend to occur in barracks. This provides support mechanisms from the developer and peers. When the system is fielded and personnel are distributed across the battle space, this type of support is no longer in place. It is important, then, to assess whether similar informal and almost invisible social network are enhancing BCSS usability during workshops. This would require isolated testing of users using video surveillance.

6. Managing IT Integration

As well as taking human interactions into account in design, a major challenge facing large organisations is how to introduce new technology and workplace change. This section summarises an ineffective, yet still used methodology. This is followed by a summary of successful techniques of technology integration.

6.1 An Unsuccessful Method of Managing Workplace Change

One of the most common methods of attempting to introduce workplace change, ergo introduce IT, has involved *Business Process Reengineering* (BPR) (Brown & Duguid, 2000). BPR focuses on identifying a business process, and sweeping away old practices. It expects people to forget all that they know, including all their hard-won, practice-based knowledge, and learn again in accordance with organisationally ordained process. What is not ordained from above as part of process risks being labelled "non-value adding" and therefore suspect. Despite high costs and a high failure rate (75%), BPR was initially enthusiastically advanced by the popular business press and was tried by a substantial number of major business firms (Bashein, Markus, & Riley, 1994). Not surprisingly, by the mid-1990s, BPR stock was plummeting as it failed to deliver the promised increases in productivity. The question that emerged was whether the focus on process overlooked knowledge-based work practices.

Notably, where BPR has succeeded, it has been in a narrow range of places, for example, procurement, shipping, and warehousing, where processes are well defined, and there are clear longitudinal links. This information helps to coordinate the complementary activities that make up a firm's critical process. However, as has been discussed, neither linear processes nor charts encompass all that goes on in organisations. BPR has had less success in the parts of organisations that are less linear and less clearly defined by process and information. Management has proven notoriously hard to reengineer. In such areas, life is less linear, inputs and outputs are not well defined, and information is less targeted. These are instead, areas where making sense, interpreting, and understanding are both problematic and highly valued – areas where meaning and knowledge enhance work practices.

The two aspects of organisations – process and practice based – look from different directions. From outside, people find meaning in functional explanations. They rely on process-based, cross-functional, longitudinal accounts of why things are done. From inside, people take a lateral view. They look to their peers for explanations of what to do and why. For them, knowledge comes from fellow practitioners rather than from cross-functional connections. These contrasting sources of meaning and understanding present BPR and process views of organisation with difficulties for several reasons. First, BPR tends to be somewhat monotheistic. There is not much room for variation in meaning in its camp. The process view is expected to explain all. Also, despite talk of rebuilding from the bottom up and empowerment, BPR tends to be relentlessly top down. These biases make it

hard to see and understand the needs of the people who make up the processes. The top-down view also tends to give a bloodless account of business. BPR begins with processes into which people are inserted as needed. While lip service is paid to personnel, improvisation and local knowledge have little place in these schema, particularly if they challenge the coordination of process.

BPR also tends to discourage the lateral links that people pursue to help make meaning. Focused on longitudinal cross-functionality, BPR tends to discourage or even disempower occupational groups, job categories, and local workplace cultures. Moreover, BPR tends to see the contrasting links within occupations groups as non-value adding. By focussing on individuals, process accounts overlook social resources that people in similar occupations provide one another. The result is quite disempowering and inefficient, burdening people with individual responsibility that is better shared by the group.

By subordinating practice to process, an organisation will also encourage its employees to mislead it. Valuing and analysing their improvisations, by contrast, can be highly informative. People rely heavily on improvisation to close the gap between the world as they find it and the inevitably limited model of that world embedded in routines and processes. Everyone also knows the value of the skilled colleague who understands how things are done – how to fill in forms, knowing what to leave blank, what does not matter. Gap-closing improvisation is one of the endless small forms of practical subversion taken in the name of getting things done (Suchman, 1996). Notably, most people are not aware of the implicit improvisation they engage in. People keep their own skills hidden, even from themselves. Think, then, of the expert military commander who explains their decision-making as intuitive. If BPR were used as a technique to introduce BCSS, this intuitive knowledge would be lost.

6.2 Methods for Successful IT Integration

6.2.1 Cold Hard Cash

Without doubt, it costs a lot of money to rapidly and successfully integrate new software systems. Microsoft, for example, are spending $16,000 per annum for each of its workstations on maintenance and upgrading (Berger, 1999). Trying to transform the way work is done and simultaneously save money is usually a mistake. The demands of turning work that has been well supported by the local social system into work that can be produced without most or all of that system, requires a commitment to transformation, not to cost-cutting.

6.2.2 The Acceptance of the Telephone

One of the most successful IT integrations of the past 100 years involved the introduction of the telephone. Notably, it was not immediately accepted. In fact, by 1878, the shareholders were becoming impatient with the slow development of the new technology that no one could really understand. Bell argued that they should abandon specialist

training, and put the phone in people's hands. In the right circumstances, he argued, the practically of the phone would do the rest. Early on, he put telephones in hotel rooms and encouraged guests to use them to perform the familiar task of talking to the front desk. In engaging a regular practice, he subtly taught people the use and the ease of the new device. Also, people who did not know how to use the system were able to observe people using it to perform a familiar task. So, the introduction of the telephone followed the social context of its time. Today e-mail and collaborative games have had profound socialising effects on anti-social technologies.

As well as suggesting a method for introducing IT, this also raises a counter-criticism to the often-heard complaint that people are not changing the way they do business, even though they have new IT. Acceptance and learning will develop more readily if the unfamiliar IT is used to conduct a familiar task in a familiar environment. This highlights to importance of providing BCSS for use in Barracks for everyday use, as well as for use during operations. This compares to the almost impossible situation where unfamiliar IT is used to conduct an unfamiliar task in an unfamiliar environment. A sub-optimal learning approach for Army, then, is one where the main learning environment for BCSS is in the field, with training or operational objectives that do not relate to the system. What the learner is faced with, then, is an unfamiliar tool, performing unfamiliar tasks in an unfamiliar/unpredictable environment. While the focus on getting users to adopt IT for familiar tasks may cause some impatience to the IT activist, process revolution should only be considered once the user has integrated the new IT into existing work practice.

6.2.3 Socially Learning to Drive

Providing a supportive learning environment in Barracks will also allow incidental or social learning to emerge. An example of highly successful social learning of a complex system involves driving. Technologically, cars are extremely sophisticated. However, they are also extremely well integrated socially. As a result, learning becomes almost invisible. This compares to our inability to program the VCR. It is hard to believe that programming a VCR is harder than driving a car. Almost everyone in our society who learns to drive has already spent a great deal of time travelling in cars or buses, along roads and highways. New drivers begin formal instruction with an implicitly structured, social understanding of the task. With the VCR, most people can use them to play tapes, but not to record, even though it is not much harder. The central distinction between these two is that one is often a social act, the other highly individual. You have people with you to watch a movie, but not to record.

Notably, the groups that are proving most successful at learning to use new technology are children and senior citizens. Despite the stereotype, senior citizens are proving adept at learning to use computers and are currently the second fastest growing group of customers (after children). Both tend to have available the time for learning, and both tend to be tied into peer groups who provide support.

Learning is also demand driven. People learn in response to need. When they cannot see the need for what is being taught, they ignore it, reject it, or fail to assimilate it in any meaningful way. Conversely, when they have a need, if the resources are available, people learn effectively and quickly. When it comes to introducing new technologies—and more importantly, getting people to use them—incentives matter. People need good reasons to change their organisational practices, as well as the time and the training to make those changes (Kling & Lamb, 2000).

7. Summary

In summary, IT design and integration requires a deep understanding of the implicit aspects of human behaviour, and the contribution of the social fabric. It must be recognised that judgement and discretion are not features of software. They are products of human socialisation and experience. They are learned not through the acquisition of facts and rules, but through social relations and participation in human activities. It is not easy to make good ones. Too often, IT design is poor because problems have been redefined in ways that ignore the social resources that are an integral part of this socialisation process. Successful design usually draws on these social resources, even while helping them change.

In terms of a system such as BCSS, then, it is vital that we recognise the importance of tacit knowledge. As was mentioned, tacit military knowledge is often found within the so-called intuitive process of planning and decision-making. It cannot be formalised, documented or easily communicated to others. It is generated via background updating that goes on constantly via voice in a military HQ, where people simply become aware of what others are up to because it is evident. Similarly, discussions in the Mess or during "mornos" allow military personnel to share their expertise and insight from operational experiences, and are critical for generating tacit knowledge.

In light of these issues, specific premises that will optimise the design and integration of this type of IT system include the following:

1. *The communication method must allow high media richness when tacit knowledge is involved*

The tacit characteristics of planning and command require high media richness. Planning and command should remain face-to-face, even if this requires the additional technology of video conferencing facilities. Using a text-based system runs the risk of losing a rich source of knowledge.

2. *Planning activities should continue to support the use of implicit communication*

Implicit communication allows us to take communicative shortcuts and tap into tacit knowledge. Formalising the planning process via an IT conduit risks turning military planning into a committee meeting.

3. *The use of directive control (mission command) should be supported*

If a tool such as BCSS attempts to enforce a rule-bound system on the complex practice of C2, it will create difficulties. Specifically, BCSS must not remove the local autonomy of personnel to make decisions when dealing with unexpected, time-pressured events.

4. *Realistic expectations need to be set as to the actual capability of the system*

The expectations of what BCSS system is able to do may be disproportionately high. Users must be given realistic guidelines about what performance increases they can expect.

5. *An appropriate level of technical support needs to be provided, no matter what the cost*

As was mentioned, if a BCSS user does not have access to social and technical resources, there is a strong likelihood that they will have some difficulty dealing with constant upgrades.

6. *Users must be allowed to adopt the system for everyday tasks before they are expected to undergo process change*

BPR is not an appropriate method of introducing a system such as BCSS as it would result in the erosion of tacit knowledge. In addition, it is necessary to provide BCSS for use in Barracks for everyday use, as well as for use during operations.

7. *Computer literacy must not become a pre-requisite for command*

Experienced military commanders should not need computer savvy to be able to lead an operation.

8. *BCSS usability needs to be evaluated in terms of isolated users*

BCSS user workshops tend to occur in barracks where invisible social networks are possibly enhancing BCSS usability during workshops.

9. *Research is required into changes that BCSS may have on the division of labour.*

Specifically, there is a requirement for research on the implications for the loss of narrow, but highly specialised skill sets in favour of broader, more generalist capabilities.

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19. ABSTRACT

The aim of this report is to summarise key aspects of human interaction that may be affected by the introduction of the Battlefield Command Support System (BCSS) to the Australian Army. Specific areas of analysis include the social nature of knowledge, implicit communication processes, and team processes. There is also discussion of common misperceptions regarding the promise of computers, and successful and unsuccessful methods of introducing new technology in relation to human interaction. It is concluded that successful design and integration of BCSS requires a deep understanding of the implicit aspects of human behaviour, and the contribution of the social fabric. A series of suggestions on how this could be achieved is provided.